QUALITY ASSURANCE PROGRAM

FOR

CLASS II FLUID SAMPLING AND ANALYSIS

UNDERGROUND INJECTION CONTROL PROGRAM

STATE OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF OIL AND GAS
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I. PLAN OVERVIEW

a) Reasons for Preparing the QA Plan

In 1983, the California Division of Oil and Gas (Division) was granted primary responsibility and authority under the Federal Safe Drinking Water Act for the regulation of underground injection related to the production of oil and gas (Class II injection). The U.S. Environmental Protection Agency (EPA) agreed to allocate and provide funds to the Division for the administration and implementation of the Underground Injection Control (UIC) Program. Grant regulations (40 CFR Part 30.503(e)) require all state agencies receiving financial assistance for programs involving environmentally related measurements to have a Quality Assurance (QA) Program for fluid testing.

The Division's Class II Quality Assurance Program applies to: (1) the verification of data received from operators in support of their underground injection projects; (2) the procedures used for routine sampling; and (3) sampling for any investigation of violations and suspected violations.

The purpose for preparing the QA Program is to assure that procedures used to obtain data are technically valid, scientifically defensible, and of known quality.

b) Regulations Relevant to the UIC QA Program

Federal regulations applicable to the Division's QA Program are: 40 CFR 30.503(e) and 146.23(b)(1).

The legal basis of the Division's authority to carry out a QA Program is contained in Sections 3000 et seq. of the Public Resources Code (PRC) and regulations contained in Title 14, Division 2, Chapter 4 of the California Administrative Code (CAC). Specifically, Sections 1724.6 through 1724.10 of the CAC stipulates the data required to be submitted for evaluation for project approval.

c) Measurements in the UIC Program Which Will Generate Chemical Data

Prior to any fluid injection, operators are required to submit a chemical analysis of the formation and injection fluid. Also, chemical analysis of formation fluids is required for aquifer exemption justification and for any investigation of known groundwater contamination episodes.

d) Participants in the Program

The companies and governmental agencies participating in the Division's Class II QA Program are: the Division of Oil and Gas, State Water Resources Control Board, State Department of Health Services Laboratories, private laboratories, oil companies injecting Class II fluids, and local water districts.

e) To Whom Applicable

The Division's Class II QA Program applies to any operator submitting data for fluid injection for enhanced recovery operations, such as waterflood or steamflood projects and for waste water disposal.

f) <u>How QA Requirements Will Be Disseminated to the Regulated Community</u>

All operators will be informed of QA requirements through:

- o An informational newsletter
- o The permit approval letter ("P" report)
- o The annual project review meetings

II. ORGANIZATION AND RESPONSIBILITY

The Division and its six district offices (see Organization Chart, Appendix A) are responsible for implementing the UIC Class II QA Program. Presently, data generated and submitted by operators for injection project approval and compliance purposes are evaluated for adequacy and validity by Division engineers. Also, each district is responsible for routine sampling and sample collection for compliance and enforcement purposes. Once the Class II QA Program is approved by the EPA, the Division district offices will be notified to begin implementing additional QA Program requirements, such as the chain-of-custody procedures and the sampling form. Also, the informational newsletter will be sent to all oil companies informing them of their responsibilities and requirements under the QA Program and the district offices will be notified to include applicable QA Program requirements in project approval letters, "P" reports (conditional permits), and at project review meetings. All data generated by the operators will be reviewed by the Division for compliance with the QA Program.

The Division and the State Water Resources Control Board (SWRCB) are involved in the evaluation of the UIC fluid chemical data. An agreement exists between the two agencies whereby the SWRCB reviews the water quality data in all injection project applications for the purpose of providing comments or additional requirements that the Division should consider prior to Division approval.

III. SAMPLING PROCEDURES

The main objectives of the Division's sampling program are: (1) to control data accuracy, and (2) to verify compliance with Division regulations by determining if there is the presence of a pollutant in surface or ground waters.

The accuracy of the chemical analysis is dependent on the sampling and sample preservation method used. By standardizing basic sampling procedures, many factors which influence data accuracy can be controlled. Some factors which may significantly affect the reliability of the analysis are cleanliness of the sampling bottles, selection of the sampling point, and the preservation and handling of the sample after collection.

The chemical analyses of collected fluid samples are used to make important project compliance decisions. Therefore, a sampling program that utilizes proper sampling techniques, coordinates with labs, and maintains accurate documentation increases the reliability of the fluid analysis.

The Division requires injection and formation fluid analyses for aquifer exemptions and project approval. Also, operators are required to submit an injection fluid sample whenever the source of that injection fluid is changed or whenever requested by the Division for use in surveillance and enforcement purposes. Formation and injection fluid samples are collected by operators or by

Division engineers. For safety and insurance reasons, Division engineers must be assisted by a company representative before handling any oilfield equipment. In many cases, injection fluid pumps need to be shut down and pressure bled off prior to opening any valves for fluid sampling. However, Division engineers may actually collect the samples with assistance and cooperation of oil company personnel.

Operators collecting fluid samples for compliance purposes must submit, along with the fluid analysis, detailed information required by the QA Program. This information includes a description of the sampling procedures used, a description of the sampling location, date and time the sample was collected, a chain of custody record, and a record of any physical measurements taken of the sample in the field (i.e., pH, temperature, suspended solids content, etc.). Furthermore, to avoid confusion and errors created when laboratories and personnel use mg/l and ppm interchangeably, the Division requires that all analysis be recorded in mg/l.

Sampling Procedures for Class II Fluids

The following procedures are developed to assist operators and Division engineers in the collection of fluid samples. In the sampling program, there are basically two types of sampling procedures: those which are systematic and those that are discretionary. Examples of systematic procedures are generally good housekeeping techniques, such as using clean sample bottles, proper handling and preservation of the samples, and accurate recordkeeping. Discretionary procedures are those that require an evaluation to select a representative sampling location, to determine the amount of fluid needed to flush the system, or to determine the number of well volumes to be evacuated prior to sampling.

It is these discretionary procedures that have the greatest effect on the accuracy of data reliability and comparability. Therefore, it is important that a diligent effort be made to follow recommended procedures, and to use the prescribed guidelines in making decisions when judgment is required during sampling.

Coordination with Laboratories

Communicating with laboratory personnel prior to sample collection is extremely important. They are an important source of information and materials for any sampling program. In many cases, the laboratories supply the necessary bottles and provide instruction on proper sample handling and preservation. Laboratories are to be contacted prior to any collection of samples in order to schedule subsequent analysis of the collected sample.

Sample Bottles

Sample containers are either polyethylene or glass. The type of container will depend upon the suspected constituents. For determining the TDS of produced brine waters, polyethylene bottles are best. Wide-mouth bottles provide easy access during both sampling and analysis. Also, an air-tight lid made of polyethylene prevents gases from escaping or air from affecting the sample fluid. The size of the bottle depends upon the analysis to be conducted and the analytical methods used. The amount of sample needed varies according to the method used in the analysis and the preservation method. For analyzing TDS of produced or injected waters, the amount of fluid collected is about one quart or two 500 ml bottles. Sufficient samples are collected for duplicate analysis should they be required.

Sample Labels

Each sample bottle is labeled and identified with the following information:

- o Date and time of sample collection
- o Operator, field, lease name, and well number
- o Section, township and range, B.M.
- o Name of individual(s) who performed the sampling
- o A description of where the sample was taken (i.e., wellhead valve, tank number, etc.)
- o Type of analysis desired
- o Any preservative used in the bottle

The label is securely fastened to the container either by the use of a peel-and-stick label or label secured with adhesive tape. Labels are not tied around the throat of the bottle or attached to the lid since labels are easily detached or the lids can be switched. (An example of the sample label is included in Appendix B.)

Sample Forms

Division engineers complete a standardized sampling form (see Attachment C) for every sample that is collected. The form contains the same information that is found on the sample label plus a description of the: (1) sample location, (2) sample procedure, (3) amount of fluid evacuated from a well or flushed through the system, (4) sample preservation used, (5) physical parameters measured in the field, and (6) detailed chain-of-custody record.

Once completed, the form is filed in the Injection Project file with a copy of the final fluid analysis.

Sampling Procedure

The important goal of the sampling program is to collect a sample that is as representative of the injection or formation fluid as possible.

For injection fluid samples, the injection fluid is collected from the injection line as close to the well head as possible. Also, samples are taken from the system when it is operating normally. In cases where injection pressures are high, it is often necessary to shut down fluid pumps and bleed pressure from the flowlines before attempting to collect the sample.

If collecting a sample from a flowline or wellhead valve after the system has been shut down for a period of time, or injection has not been constant, it may be necessary to let the water run out for a few minutes in order to flush the system. A judgment is made in order to determine when to collect the best sample. In many cases, the appropriate time is when the color of the water becomes constant. In cases where this is not possible, many samples are collected over a determined period of time such as every 5 or 10 minutes. These samples are either combined into one large sample (composite sample) or analyzed as individual samples.

Before filling, sample bottles are rinsed out two or three times unless a preservative has been added to the bottle. If a sampling valve is available, a sampling tube is used to prevent aeration of the sample fluid when filling the sampling bottle. This becomes increasingly important as the turbidity of the fluid increases. The use of a sampling tube creates an even flow of fluid from the flowline valve into the sample container. When sampling with a sampling tube, the end of the tube is placed in the bottom of the bottle until the bottle overflows for an estimated 10 volumes. The tube is then slowly pulled from the bottle. To ensure a vacuum seal, the sides of the plastic bottle are squeezed and the cap is then screwed on tightly.

If a sampling valve is not available, then care should be taken to prevent turbulence in the fluid stream as it comes from the flowline or wellhead valve. This is accomplished by controlling the opening of the valve filling a large container with the sample fluid and submerging the sample bottle in the container. The bottle is capped while it is still submerged. A label is prepared immediately and affixed to the sample bottle.

The purpose of preventing aeration of the fluid and of capping the bottle immediately is to lessen the contact of the sample with oxygen and to minimize the loss of any dissolved gas. This becomes increasingly important when collecting formation fluid samples. A list of analytical determinations and measurements that are influenced by atmospheric oxygen and those which are not, are listed in Appendix D.

When sampling a storage tank, care is taken to ensure that a representative sample is taken. Considerable stratification of fluids can occur in a tank if injection is intermittent. Therefore, samples are taken at different depths from the liquid surface to the bottom. If the design of a tank permits, then samples are collected from at least three lateral positions as well as different depths. These samples are mixed into one composite sample for analysis.

If it is not possible to collect a storage tank sample from the top of a tank because there is no available sampling hatch, then the sampling valve on the tank or on the flowline leading from the tank is used.

Formation Fluid Samples

The collection of a representative formation fluid sample is very complex. There are many factors influencing collection procedures which cannot be completely controlled. Localized conditions within an aquifer make selection of a sampling location difficult. Differences in the physical parameters (i.e., temperature and pressure) at the surface results in changes to the chemical composition of the fluid. The presence of drilling contaminants near the well bore (i.e., drilling mud, acid, etc.) or on equipment can drastically affect the fluid analysis. These and many other important factors must be analyzed prior to designing a sampling program. A thorough knowledge of all the factors that can potentially affect the chemical composition of the formation fluid will enable the sampler to make decisions that will increase the reliability of the fluid analysis.

For a more in-depth description of formation fluid sampling techniques and procedures, the Division's Injection Manual and other technical reports should be consulted. However, a brief description of the more common sampling methods is described as follows.

Methods used to collect formation fluid samples differ considerably from those used to collect injection fluid samples. In most cases, the collection of subsurface fluid samples involves using a rig to run a drill-stem test, a bailer, or a swab. Also, a formation sample can be collected from a well producing in the same zone.

The drill-stem test, if properly done, can provide a reliable formation water sample. A drill-stem test is a technique whereby a zone in an open or cased hole is isolated by an expandable packer or packers and fluid from the formation allowed to flow through a valve into a drill pipe. If a drill-stem test is run during drilling operations, there is a high risk of contamination from drilling mud. However, a representative formation fluid sample can be collected if the test is run properly. During the test, mud filtrate will be the first fluid to enter the test tool, and it will be found in the upper part of the fluid column. Therefore, a representative formation fluid sample will be found at some point down the column. This point is variable and is influenced by the rock characteristics, mud pressure, type of mud, and the duration of the test.

Usually, samples of the fluid are collected as each stand of pipe is removed. A measurement of the resistivity is taken for each sample. A total dissolved solids (TDS) value can then be calculated from the resistivity (Rw). The most representative sample should be collected where the TDS becomes relatively constant.

Bailing is one of the simplest methods of collecting a formation fluid sample. A bailer is raised and lowered in a well to collect individual small volumes of fluid. The nature of the technique itself may make it very impractical to evacuate a large volume of water from the well bore. Also, care must be taken to ensure that the water sample is representative of the formation of interest and not of another formation also draining into the well. This problem is reduced if zones are isolated by either cemented casing or packers. In any event, the use of a bailer as a sampling tool must be evaluated on a case-by-case basis.

Swabbing is a method of producing fluid similar to pumping a well. In swabbing, fluid is lifted from the well bore through drill pipe, casing, or tubing by a swab that falls freely downward through the pipe and its contained fluid, but which seats against the pipe wall on the up-stroke, drawing a volume of fluid above it as it is raised.

Swabbing is preferable to drill-stem testing where unconsolidated formations cause testing to be difficult. Swabbing may also be used in conjunction with drill-stem testing to increase the volume of fluid obtained. The advantage of swabbing is that it can be continued until all drilling mud has been drawn from the pipe. This procedure helps to ensure that a representative sample of formation water is obtained.

It is common practice to collect a sample of formation water from a valve at the wellhead. A plastic tube can be used to transfer the fluid from the wellhead into a container. In most cases, the fluid will be a mixture of oil and water. Therefore, a large container or an oil-water separator with a valve at the bottom is required. The sample can then be collected from the bottom of the separator. To prevent mixing of oil and water, care should be taken to prevent turbulent flow from the wellhead valve into the oil-water separator. In some instances, it is necessary to discontinue the flow from the well and let the oil and water separate in the separator before collecting the sample.

As previously mentioned, it is important to remove several well volumes of water from a well prior to collecting a sample. The amount of water that should be removed from the well is dependent on the diameter of the well and the depth to the formation being sampled. A general rule is to evacuate three to five times the volume of water from the surface to the zone. For samples collected directly from a producing well, it is not necessary to evacuate a volume of the well; however, the well should be allowed to run just enough to flush out any contaminants in the valve.

IV. SAMPLE PRESERVATION AND CHAIN OF CUSTODY

Sample Preservation

The importance of sample preservation, especially for formation fluid samples, cannot be overemphasized. The quality of the sample analysis can only be assured through the maintenance of good procedures from the time the sample is collected until it is delivered to the lab.

The object of preservation techniques is to preserve the stability of the constituents in the fluid. At best, the preservation technique can only retard the chemical and biological change that takes place in a fluid sample after it is removed from its source. Small changes in pressure, temperature, or exposure to the atmosphere can result in significant changes to the concentration of the chemical components in the sample. For example, a change in fluid pressure would have the effect of releasing dissolved carbon dioxide to the atmosphere which in turn would cause a change of the pH resulting in the precipitation of calcium carbonate. The analysis would then show a low reading of both carbon dioxide and calcium content.

Methods of preservation are relatively limited and are intended to retard biological action, retard hydrolysis of chemical compounds, and reduce the volatility of constituents. Preservation methods are limited to pH control, chemical addition, refrigeration, and freezing. The laboratory doing the analysis should be consulted for information on the proper preservation technique for the parameter being sampled. For TDS, the preservation technique is limited to refrigerating the sample to 4^{o} C, with a maximum holding time of seven days. (See Appendix E for a list of preservation techniques and maximum holding times for a few parameters.) Sample preservation should be performed in the field immediately after sample collection.

Field measurements can provide laboratories with important information on the physical state of the fluid at the time it was collected. Also, these measurements can be used by the engineer to evaluate the results of the chemical analysis. Armed with basic knowledge of how certain physical changes affect chemical composition, the engineer can better evaluate the sample analysis, communicate with laboratories, and make compliance decisions based on firm evidence.

Engineers collecting fluid samples witness the field measurements taken by company personnel or take the measurements themselves. Division engineers are trained in the use of simple field instruments. However, in some cases, it is more practical to witness the measurements since some measurements require specialized equipment. Again, the laboratory doing the analysis will be able to provide a list of field measurements needed.

The most common and simplest field measurements are temperature, pH, and conductivity. The parameters of temperature, pH, and electrial conductivity begin to change rapidly as soon as the sample is removed from the well. A temperature reading of the fluid should be taken immediately. Also, the conductivity can be measured easily with the use of a conductivity meter.

For a pH measurement, a pH meter can be used if available. (Note: To ensure that thermometers, pH meters, and conductivity meters are calibrated correctly, see Section V.) All physical measurements, as well as procedures used to take the measurements, should be described on the sample label and sample form.

Chain of Custody Procedures

Any sample analysis used as evidence to support litigation must be able to provide a chain of custody of the sample.

The objective of the chain of custody procedure is to create an accurate written record which can be used to trace the possession of the sample from the moment of its collection through the analysis and until it is introduced as evidence. A sample is defined by EPA as being in someone's "custody" if:

- It is in one's actual possession; or
- It is in one's view, after being in one's physical possession; or
- It is in one's physical possession and then locked in a secure place; or
- It is kept in a secured area, restricted to authorized personnel.

The number of persons handling the sample is kept to a minimum. The sampling form is completely filled out, signed, and dated by the person responsible for collecting or overseeing the collection of the sample. The sample bottle is sealed with tape or a comparable seal around the cap, in a way that tampering would be easy to detect.

When transferring the sample, the transferee must sign and record the date and time and to whom the sample was transferred. Every person who takes custody must fill in the appropriate section of the chain of custody record. To minimize custody records, a Division engineer takes the sample directly to the laboratory doing the analysis. This will not only ensure custody, but also will minimize the length of time from sample collection to analysis. If the sample analysis is to be used for litigation, the laboratory is instructed to handle the sample as a custody one and keep it locked except during the analysis.

The sampling form containing the chain of custody record is filed in the project file. At the time the analysis is returned, a note is made in the record, on the sampling form.

V. LAB AND FIELD EQUIPMENT CALIBRATION

When field equipment is used by Division engineers, it is limited to a conductivity meter and a thermometer. The conductivity meter is calibrated against a standard KCL solution and stored according to the manufacturer's specifications. Before sampling, checks are made for measurement reliability. Also, the fluid vessel in the meter is cleaned with distilled water after every use. Thermometers are calibrated against a National Bureau of Standards certified thermometer. This calibration can be done by the lab at the time the sample bottles are picked up prior to sampling. Also, if a pH meter is used, the meter is calibrated using two buffers which bracket the pH of the sample. For example, if the sample pH is around 5, then pH 4 and pH 7 buffers would be used. It is important to note that the use of a pH meter and a thermometer is mainly used when sampling formation fluids, since they are very susceptible to temperature and pressure changes during sampling.

The calibration of laboratory equipment is not applicable to the Division's QA program since the Division does not exercise authority over labs. As mentioned in a previous report on the status of the State's lab certification program, the State Department of Health Services is responsible for the regulation of laboratories.

VI. ANALYTICAL PROCEDURES

Laboratories performing fluid analysis on samples collected for the Division Class II UIC Program are sent a copy of the Federal Register containing EPA accepted methodologies with instructions that these procedures be followed. (Note: The Federal Register is sent only if the lab does not already have the appropriate Federal Register.)

VII. DOCUMENTATION, DATA REDUCTION, VALIDATION, AND REPORTING

Detailed documentation procedures of all samples and methods of collection are explained in the Sampling Procedure section. All pertinent information related to the sample collection, field measurements, and sample custody are recorded on a standardized form and retained in the project file.

Data validation of laboratory analytical procedures is outside the expertise and authority of the Division.

The comparison of known data with analytical results of a sample is discussed in the section on "Data Representativeness, Comparability, and Completeness".

VIII. INTERNAL QA CHECKS

The Division uses only those labs certified by the State or labs proven to be reliable in the analysis of waste water samples. All quality control checks are performed by each laboratory in conformance with State lab certification requirements. However, a list of Quality Control Procedures (see Appendix F) is submitted to the lab performing the analysis with instructions that these procedures be followed. This list pertains to standard curve data, standardization of titrants, electrochemical methods, analytical balances, duplicate analysis, and spiked sample analysis. Once the certification program for labs performing waste water sample analysis is complete, the Division will rely on those certified labs.

IX. PERFORMANCE AND SYSTEMS AUDITS

Performance and system audits performed by the Division are limited to the use of Quality Control (QC) samples. The Division provides the laboratories with "QC samples" for analysis. The evaluation of the results with the true values indicates the quality of the analysis done by the lab. Samples used for Quality Control may be provided by the EPA or the Division may use split samples between two labs. These QC checks would be performed periodically and mainly with labs used regularly by the Division. (See Appendix G for a list of available EPA QC samples.)

X. PREVENTIVE MAINTENANCE

The Division is not responsible for any preventive maintenance program for laboratories.

XI. PRECISION ACCURACY PROTOCOLS

The selection of analytical methods and the determination of the data precision and accuracy is outside the realm of the Division's expertise. These determinations and guidelines are established by the Department of Health Services and the Water Resources Control Board.

XII. DATA REPRESENTATIVENESS, COMPARABILITY, AND COMPLETENESS

The data representativeness and recommendations on sampling locations have been addressed in Section III under "Sampling Procedures".

The Division assures data comparability in two ways. As mentioned in a previous section, all analyses submitted must be in the standard mg/l units. Also, water analyses received from operators or from samples collected by the Division are reviewed and evaluated for adequacy and validity by comparison with analyses and data submitted in support of other projects. A check can be done by comparing total dissolved solids (TDS) values from the analysis with electrical, physical, and chemical logs on file with the Division.

In the evaluation of data submitted for compliance and enforcement purposes, the logs can be used to compare ppm values for a particular zone with the water analysis submitted in the project application.

Water resistivity values (Rw) can be calculated from spontaneous-potential (SP) curves and other values on the electric logs. This information is then converted to a TDS value and compared with the water analysis. Also, other sources of information are used in making comparisons of water quality, such as water quality data compiled by other governmental agencies and oil companies. This information is on file at each of the Division's district offices.

XIII. CORRECTIVE ACTION

Data that is not of acceptable quality or of questionable validity can be rejected by the Division and a request made to witness and/or collect another fluid sample. The acceptability of analysis results is determined by the comparison of the analysis with known data as stated in Section XII and by the evaluation of Quality Control procedures.

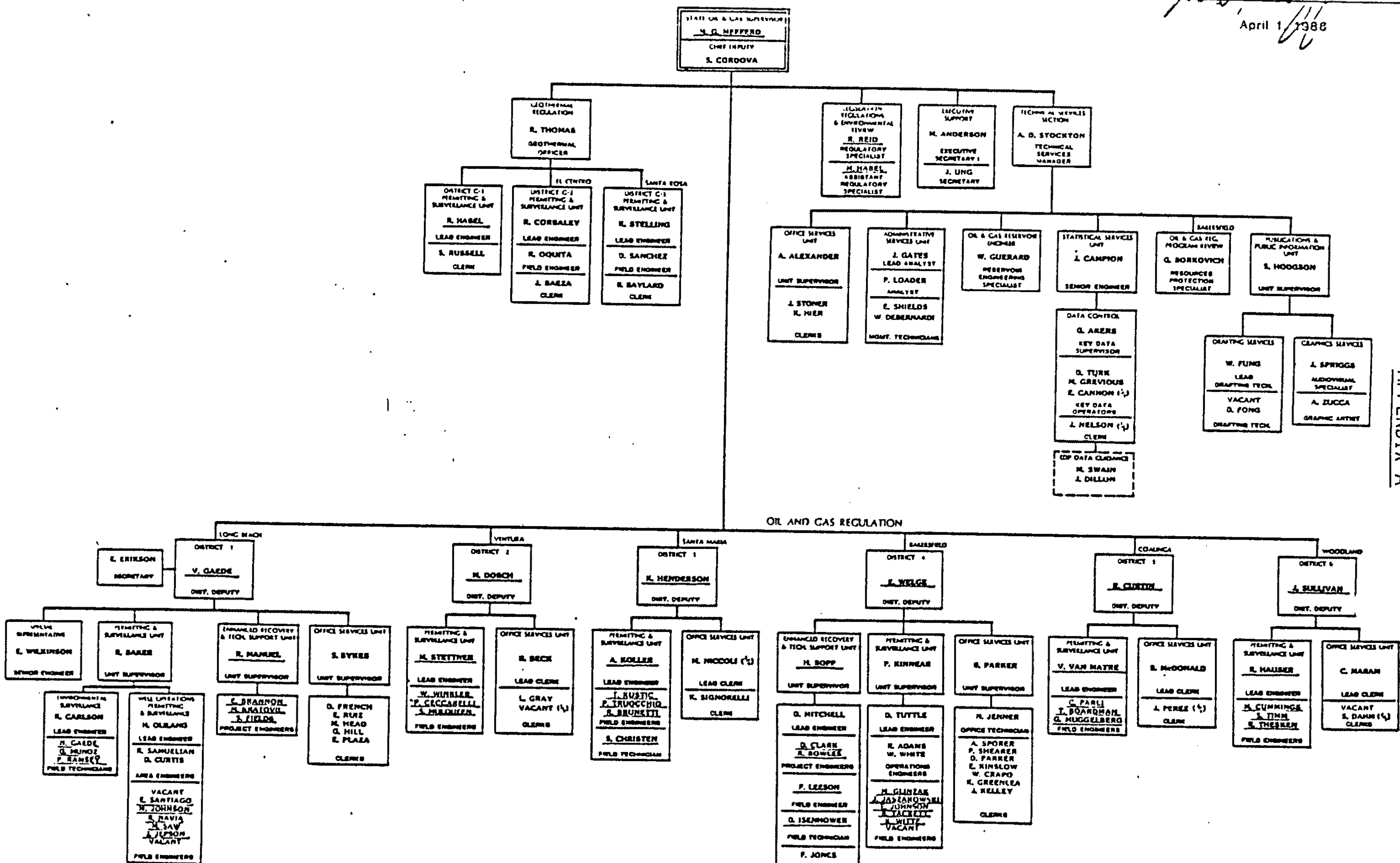
XIV. QUALITY ASSURANCE REPORTS

Information on all QA procedures, samples collected and analyzed are contained in the Division's injection project files. This information is available to the EPA for its inspection during the file review.

APPENDIX A

DIVISION OF OIL & GAS ORGANIZATION CHART

APPROVED [signature]
April 1, 1988



*Names underlined in red point out engineers involved in the Divisions UIC Program.

APPENDIX B

FLUID SAMPLE LABEL

Date_____________________________ Time____________________

Operator__________________________ Field ___________________________

Lease name__________________________ Sec._____T._____ R._____ _____B.&M.

Well number or sample location____

Where sample collected____

Person(s) collecting sample/witnessing collection__________________________

Type of analysis____________________ Preservative______________________

APPENDIX C

UIC INJECTION PROJECT

FLUID SAMPLING AND CHAIN OF CUSTODY FORM

Injection Project Name:____________________ Date:____________________

Operator:____________________ Field:____________________

Lease:____________________ Well Name, No.:____________________

Engineer:____________________ Sec.____ T.____ R.____ ____B.&M.

Sampling Location: (Give a detailed description of where sample was collected.)

Sample Description:

Source: (Give geologic formation, zone; if other well give well name, number, zone, depth to perfs, zone depth (TVD) if available.)

Color:____________________ Odor:____________________

System Operation at Time of Sampling: (Was system functioning normally, shut down? Describe any abnormalities.)

Physical Measurements Taken in Field:

Temperature:__________ Electrial Conductivity:__________ pH:__________

Other:____________________

Number of Samples Collected: (Only give number of samples collected from same sampling location.)

Lab Name:____________________

Type of Analysis____________________

Preservative____________________

CHAIN OF CUSTODY:

Relinquished by:	Date	Received by:	Time	Reason for Change of Custody
1)		1)	1)	
2)		2)	2)	
3)		3)	3)	

APPENDIX D

Measurements and analytical determinations influenced by contact with atmospheric oxygen.[1]

Alkalinity	Hydrogen sulfide
Ammonia	Manganese
Bicarbonate ion	Nitrite
Calcium ion	Oxygen
Carbon dioxide	pH
Carbon ion	Specific conductance
Ferric ion	Specific gravity
Ferrous ion	Sulfide ion
Hardness	Sulfite ion
Hydroxide ion	Sulfur dioxide

Those not influenced by contact with atmospheric oxygen.

Aluminum ion	Microorganisms
Barium ion	Nitrate ion
Bromide ion	Odor
Chloride ion	Phosphate ion
Chromate ion	Potassium ion
Copper ion	Silica
Cyanide ion	Sodium ion
Flouride ion	Solids
Iodide ion	Sulfate ion
Lead ion	Turbidity
Magnesium ion	

APPENDIX E

Parameter	Preservation Technique	Maximum Holding Time
Major Cations (Na^+, K^+, Ca^{+2}, Mg^{+2})	HNO_3 to pH < 2.0	6 months
Major Anions (Cl^-, $SO_4^=$, F^-, Br^-)	Chill to 4^o C	1 month
Trace Metals (Fe, Mn, Zn, Pb, Hg)	HNO_3 to pH < 2.0	6 months
Alkalinity	Chill to 4^o C	14 days
Sulfide	Chill to 4^o C	7 days
	2nd Zn Acetate Reagent per liter, NaOH to pH > 9.0	
pH	None	1 hour maximum
Dissolved Oxygen	Meter method - none	Determine on-site
	Winkler method - add	8 hours
	$MnSO_4$ and Azide - NaOH reagents	
Specific Conductance	Chill to 4^o C	28 days
Total Dissolved Solids	Chill to 4^o C	7 days
Compatability	Chill to 4^o C	48 hours

(Reproduced from EPA - QA Guidelines)

APPENDIX F

Practices such as those listed below must be implemented in labs to ensure adequate quality control.

1. Standard Curve Data - Where applicable, standard curves must be checked and calibrated at least weekly. This requirement applies to atomic emission, ion chromatographic and colorimetric methods. Atomic absorption curves should be obtained daily.

2. Standardization of Titrants - When standard solutions (titrants) are used for quantitative analyses to determine the concentration of pollutants, these titrants must be standardized monthly or more frequently if the method requires it.

3. Electrochemical Methods - Electrochemical instruments must be standardized each day (or shift) in which they are used. These standardization procedures can be found either in the methods text used or manufacturer's instructions for the instrument.

4. Analytical Balances - Because the balances are the primary standard in the laboratory, care must be taken to ensure their accuracy. Each balance should be serviced annually. In addition, Class "S" weights must be weighed quarterly to document accuracy or to detect problems so corrective action can be taken.

5. Duplicate Analyses - Duplicates are used as a check on the lab procedures. Duplicate analyses must be done on at least ten percent (10%) per sample matrix/type of the UIC samples received. If there are less than 10 samples in a batch, one duplicate analysis should be done. Results of these analyses must fall within EPA acceptance limits for precision.

6. Spiked Sample Analyses - Spiked sample analysis allows the laboratory personnel to evaluate the accuracy of the sampling method performed on a routine basis. A spiked sample is created by adding a known amount of the constituent being analyzed to a representative portion of the original sample. The amount of spike should be approximately equal to the concentration of the analyte in the original sample. At least 10% spikes or one per batch (if less than 10 samples per batch) must be run.

QA Support for Water and Wastewater Analyses EMSL-Cincinnati

QC Sample Program

QC samples are furnished without charge to interested governmental, industrial, commercial, and private laboratories for use as secondary checks on their within-laboratory QC programs. The samples, provided with true values, are intended as independent checks of technique, methodology, and standards, not as replacement for the standards, replicates or spike samples run routinely as part of the laboratory's own QC program.

There is no certification or other formal evaluative function resulting from the use of QC samples and data return is not expected. The QC Sample Program covers the ambient water quality, drinking water, water pollution, priority pollutant, hazardous, and toxic waste programs for chemical, biological, and microbiological parameters. Most samples are prepared as concentrates in water or organic solvent (where noted) and sealed in glass ampuls. Instructions are provided for dilution of samples to volume with water or wastewater prior to analysis. The following samples are available now:

QC Samples for Water Quality Analyses

DEMAND ANALYSES	*BOD, COD, TOC, two levels*
LINEAR ALKYLATE SULFONATE	*LAS, the anionic surfactant standard for the MBAS Test*
MINERAL/PHYSICAL ANALYSES	*sodium, potassium, calcium, magnesium, pH, sulfate, chloride, fluoride, alkalinity/acidity, total hardness, total dissolved solids, and specific conductance, two levels*
MUNICIPAL DIGESTED SLUDGE	*26 parameters (metals, nutrients, demands, residues, and phenols)*
NON-FILTERABLE, VOLATILE AND TOTAL FILTERABLE RESIDUE	*two, three levels*
NUTRIENTS	*nitrate-N, ammonia-N, Kjeldahl-N, orthophosphate, and total P, two levels*
OIL AND GREASE	*three levels, 2 analyzable by IR and 3 analyzable gravimetrically*
PESTICIDES IN FISH	*toxaphene, DDD, DDE, DDT*
PHENOLS (4AAP METHOD)	*two levels*
POLYCHLORINATED BIPHENYLS (PCBs) IN FISH	*naturally-polluted fish tissue containing Aroclors 1242, 1254 and/or 1260, two levels*
POLYCHLORINATED BIPHENYLS (PCBs) IN OILS	*Aroclor 1016, 1242, 1254, and 1260 in transformer, hydraulic, and capacitor oils, three levels (specify Aroclor and oil)*
POLYCHLORINATED BIPHENYLS (PCBs) IN SEDIMENTS	*natural sediments containing Aroclor 1242 and/or 1254, three levels*
TRACE METALS - WP I	*aluminum, arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, vanadium, and zinc, two levels*
TRACE METALS - WP II	*antimony, silver, and thallium, two levels*
TRACE METALS - WP III	*barium, calcium, potassium sodium, magnesium, molybdenum, and titanium, two levels*

.ACE METALS IN FISH	arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc, one level
VOLATILE ORGANICS	chloroform, 1,2-dichloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethylene, carbon tetrachloride, 1,1,2,2-tetrachloroethylene, bromodichloromethane, dibromochloromethane, and bromoform, two levels, in methanol

QC Samples for Priority Pollutants/Hazardous Wastes/Toxic Chemicals

AROMATIC PURGEABLES	benzene, toluene, ethylbenzene, p-xylene, o-xylene, and m-xylene, two levels, in methanol
BENZIDINES	benzidines and 3,3'dichlorobenzidine, two levels, in methanol
CHLORINATED HYDROCARBONS	hexachloroethane, hexachlorobenzene, 1,2,4-trichlorobenzene, o-dichlorobenzene, p-dichlorobenzene, m-dichlorobenzene, hexachlorobutadiene, 2-chloronaphthalene, two levels, in acetone
CHLORINATED HYDROCARBON PESTICIDES - WP I	aldrin, dieldrin, DDT, DDE, DDD, and heptachlor, two levels, in acetone
CHLORINATED HYDROCARBON PESTICIDES - WP II	chlordane, two levels, in acetone
CHLORINATED HYDROCARBON PESTICIDES - WP III	alpha-BHC, beta-BHC, heptachlor epoxide, endrin, aldehyde, and alpha and beta Endosulfan, two levels, in acetone
CYANIDE	two levels
DICHLOROBENZENES	three sets: meta and para isomers, meta and ortho isomers, and meta, ortho and para isomers, two levels each, in methanol
EP METALS	arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, two levels each, in acetic acid
GC/MS ACIDS	2-chlorophenol, 2-nitrophenol, phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-chloro-3-methylphenol, pentachlorophenol, 2-methyl-4,6-dinitrophenol, and 4-nitrophenol, two levels, in methanol
GC/MS BASE NEUTRALS - I	bis-2-chloroethyl ether, 1,3-dichlorobenzene, 1,2-dichlorobenzene, nitrosodipropylamine, isophorone, bis-2-chloroethoxy methane, 1,2,4-trichlorobenzene, hexachlorobutadiene, 2-chloronaphthalene, 2,6-dinitrotoluene, 2,4-dinitrotoluene, diethyl phthalate, hexachlorobenzene, phenanthrene, dibutyl phthalate, pyrene, benzo(a)anthracene, dioctyl phthalate, benzo(k)fluoranthene, two levels, in methanol
GC/MS BASE NEUTRALS - II	1,4-dichlorobenzene, bis-2-chloroisopropyl ether, hexachloroethane, nitrobenzene, naphthalene, dimethyl phthalate, acenaphthene, fluorene, 4-chlorophenyl phenyl ether, 4-bromophenyl phenyl ether, anthracene, fluoranthene, butyl benzyl phthalate, benzo(a)pyrene, benzo(b)fluoranthene, benzo(a,h)anthracene, benzo(g,h,i)perylene, two levels, in methanol

GC/MS BASE NEUTRALS - III	4-chlorobenzotrifluoride, m-chlorotoluene, 2,4-dichlorotoluene, 1,3,5-trichlorobenzene, 1,2,4,5-tetrachlorobenzene, 1,2,3,4-tetrachlorobenzene, 2,4,6-trichloroaniline and pentachlorobenzene, two levels in acetone
GC/MS PESTICIDES - I	alpha-BHC, gamma-BHC, heptachlor, heptachlor epoxide, dieldrin, endrin, and 4,4'-DDD, two levels
GC/MS PESTICIDES - II	beta-BHC, delta-BHC, aldrin, alpha and beta Endosulfan, 4,4'-DDE, and 4,4'-DDT, two levels
GC/MS PURGEABLES - I	1,1-dichloroethane, chloroform, 1,1,1,trichloroethane, bromodichloromethane, bromoform, cis and trans 1,3-dichloropropane, and tetrachloroethene, two levels, in methanol
GC/MS PURGEABLES - II	methylene chloride, 1,1-dichloroethene, trans 1,2-dichloroethene, 1,2-dichloroethane, carbon tetrachloride, 1,2-dichloropropane, trichloroethene, dibromochloromethane, 1,1,2,2-tetrachloroethane, and chlorobenzene, two levels, in methanol
GC/MS PURGEABLES - III	bromochloromethane, cis 1,3-dichloroethene, 2,3-dichloro-1-propene, 1,2-dibromomethane, 1,2-dibromo- 3-chloropropane and o-chlorotoluene, two levels in acetone
GC/MS PURGEABLES - IV	o-xylene, m-xylene, p-xylene and p-chlorotoluene, two levels in methanol
HALOETHERS	bis (2-chloroisopropyl ether, bis (2-chloroethoxy) methane, bis (2-chloroethyl) ether, 4-chlorophenyl phenyl ether, 4-bromophenyl phenyl ether, two levels, in acetone
HALOGENATED PURGEABLES - I	chloromethane, chloroethane, methylene chloride, 1,1-dichloroethylene, trans 1,2-dichloroethylene, carbon tetrachloride, bromodichloromethane, and 1,1,2-trichloroethane, two levels, in methanol
NITROAROMATICS AND ISOPHORONE	isophorone, nitrobenzene, 2,4-dinitrotoluene, and 2,6-dinitrotoluene, two levels, in acetone
NITROSAMINES	N-nitrosodimethylamine, N-nitrosodipropylamine, N-nitrosodiphenylamine, two levels, in acetone
PHENOLS (GC)	phenol, 2,4-dimethylphenol, 2-chlorophenol, 4-chloro-3-methylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, pentachlorophenol, 2-nitrophenol, 4-nitrophenol, and 2,4-dinitrophenol, in acetone
PHTHALATE ESTERS	dimethyl phthalate, diethyl phthalate, di-n-butyl phthalate, butyl benzl phthalate, diethyl hexyl phthalate and dioctyl phthalate, two levels, in acetone
POLYCHLORINATED BIPHENYLS	separate samples available for Aroclor 1016, 1221, 1232, 1242, 1248, 1254, 1260 and 1262 in acetone (laboratory must request specific Aroclor needed)
POLYNUCLEAR AROMATICS - I	acenaphthene, anthracene, benzo(k)fluoranthene, chrysene, naphthalene, and pyrene, two levels, in acetone

POLYNUCLEAR AROMATICS - II	*acenaphthylene, 1,2-benzathracene, benzo(b)-fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, dibenzo(a,h)anthracene, fluoranthene, and phenanthrene, two levels, in acetone*
POLYNUCLEAR AROMATICS HYDROCARBONS - (PNA) SRM 1647	*naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(k)fluoranthene, benzo(a)pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, in acetonitrile, 5 ampuls/set*

PLEASE NOTE: Free distribution of limited quantities of SRM 1647 is restricted to EPA laboratories, EPA contractor laboratories, and state or local government laboratories. Others may purchase SRM 1647 directly from the National Bureau of Standards, Office of Standard Reference Materials, B-311 Chemistry Building, Washington, D.C. 20234, (301) 921-2045.

QC Samples for Drinking Water Analyses

CORROSIVITY/SODIUM	*Langelier's Index Value and Sodium in water, one level*
HERBICIDES	*2,4-D, 2,4,5-TP (Silvex), two levels, in methanol*
NITRATE/FLUORIDE	*nitrate-N and fluoride, two levels*
CHLORINATED HYDROCARBON PESTICIDES - WS I	*endrin, lindane, and methoxychlor, two levels, in acetone*
CHLORINATED HYDROCARBON PESTICIDES - WS II	*toxaphene, two levels, in acetone*
RESIDUAL FREE CHLORINE	*two levels*
TRACE METALS - WS	*arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver, two levels*
TRIHALOMETHANES	*chloroform, bromoform, dichlorobromomethane, and chlorodibromomethane, two levels, in methanol*
TURBIDITY	*two levels*

QC Samples for Biology/Microbiology

CHLOROPHYLL	*fluorometric analyses, three levels, in acetone*
CHLOROPHYLL	*spectrophotometric analyses, one level, in acetone*
PHYTOPLANKTON	*duplicate ampuls preserved, in 15 mL of water. One ampul for use in taxonomic evaluation while the other for enumeration and identification of organisms (Sedgwick-Rafter counts)*
SIMULATED PLANKTON	*20 mL aqueous suspension of latex spheres for particle counting, and a permanent, glass slide mount of latex spheres for particle size distribution determinations*

The USEPA Repository for Toxic and Hazardous Materials

EMSL-Cincinnati maintains the USEPA Repository for Toxic and Hazardous Materials to provide a continuing source of calibration materials, standards, reference compounds, and spiking solutions for all trace organics of interest to the Agency, *not including pesticides or radioisotopes,* which are available from EMSL-Las Vegas, *nor trace organic air pollutant calibrants,* available from EMSL-Research Triangle Park. The Repository provides support for the ambient monitoring, drinking water, National Pollutant Discharge Elimination System (NPDES) priority pollutants, hazardous waste/solid waste, and toxics programs.

Compounds are prepared individually as 1.5 mL solutions in water-miscible solvents sealed in all-glass ampuls. A data sheet with each ampul contains general chemical data, solution specifications, storage and preservation recommendations, information on purity and health hazards, and safe handling instructions. Included with each data sheet is a gas chromatography or high performance liquid chromatography chromatogram showing relative peak areas, retention times of the compound, and impurities, if any. The chromatograms are obtained using detector conditions specified in USEPA's methods.

Three grades of materials will be distributed:

- Quality Assurance Standards (QAS)>99% purity
- Quality Assurance Reagents (QAR) 95-98% purity
- Quality Assurance Technical Materials (QAT)<95% purity

The Repository will move as many compounds as possible from the QAT and QAR categories into the QAS category by use of purification techniques. Exceptions are multicomponent materials such as polychlorinated biphenyls (PCB's), polychlorinated naphthalenes (PCN's), and toxaphene which will be categorized as QAR or QAT and will not be purified further. The current list of the Repository materials distributed is given in the following table:

Concentrations are 5,000 µg of QAS-pure compound per mL of methanol solvent unless otherwise noted.

E001 Acenaphthene
E003 Acrylonitrile
E005 Benzidine
E007 1,2,4-Trichlorobenzene
E009 1,2-Dichloroethane (10,000 µg/mL)
E011 Hexachloroethane
E014 1,1,2,2-Tetrachloroethane (10,000 µg/mL) (QAR)
E017 2-Chloroethyl vinyl ether (10,000 µg/mL) (QAR)
E020 p-Chloro-m-cresol
E022 2-Chlorophenol
E025 1,4-Dichlorobenzene
E029 2,4-Dichlorophenol
E030 1,2-Dichloropropane (10,000 µg/mL)
E034 2,6-Dinitrotoluene
E037 Fluoranthene
E039 4-Bromophenyl phenyl ether
E041 bis(2-Chloroethoxy) methane (QAR)
E046 Dichlorobromomethane (10,000 µg/mL)
E051 Hexachlorocyclopentadiene
E053 Naphthalene
E055 2-Nitrophenol
E057 2,4-Dinitrophenol (QAR)
E059 N-Nitrosodimethylamine
E061 N-Nitrosodi-n-propylamine
E063 Phenol
E065 Butyl benzyl phthalate
E067 Di-n-octyl phthalate
E069 Dimethyl phthalate

*E002 Acrolein (10,000 µg/mL)***
E004 Benzene (10,000 µg/mL)
E006 Chlorobenzene (10,000 µg/mL)
*E008 Hexachlorobenzene (1000 µg/mL)**
E010 1,1,1-Trichloroethane (10,000 µg/mL) (QAR)
E013 1,1,2-Trichloroethane (10,000 µg/mL) (QAR)
*E015 Chloroethane (10,000 µg/mL)****
E016 bis(2-Chloroethyl) ether
E018 2-Chloronaphthalene (10,000 µg/mL) (QAR)
E019 2,4,6-Trichlorophenol (QAR)
E021 Chloroform (10,000 µg/mL)
E023 1,2-Dichlorobenzene
E026 3,3'-Dichlorobenzidine (QAR)
E028 trans-1,2-Dichloroethylene (10,000 µg/mL)
E033 2,4-Dinitrotoluene (QAR)
E036 Ethylbenzene (10,000 µg/mL)
E038 4-Chlorophenyl phenyl ether
E040 bis(2-Chloroisopropyl) ether (QAR)
E042 Methylene chloride (10,000 µg/mL)
E050 Hexachlorobutadiene (QAR)
E052 Isophorone
E054 Nitrobenzene
E056 4-Nitrophenol
E058 4,6-Dinitro-o-cresol
E060 N-Nitrosodiphenylamine
E062 Pentachlorophenol
E064 bis(2-Ethyl hexyl) phthalate
E066 Di-n-butyl phthalate
E068 Diethyl phthalate

Please Print or Type.

Form Approved O.M.B. 2000-0139
Exp. 4-30-86

Quality Control Sample Request

Name ______________________________

Company ______________________ Telephone __________

Laboratory ______________________________

Address ______________________________

City ______________________ State __________ Zip Code __________

Approval of Laboratory Director ______________________________

Please indicate Programs for which QC samples are requested:

___ Drinking Water ___ Wastewater ___ Toxics (TSCA) ___ Ambient Monitoring ___ Solid Waste/Hazardous Wastes (RCRA)

Water Quality/Water Pollution Samples

___ Demand
___ LAS
___ Mineral
___ Mun. Digested Sludge
___ Nutrients
___ Oil & Grease
___ Pesticides in Fish
___ PCBs in Fish
___ PCBs in Sediments
___ Phenols (4AAP Method)
___ Trace Metals WP - I
___ Trace Metals WP - II
___ Trace Metals WP - III
___ Trace Metals in Fish
___ Residues
___ Other__________

PCBs in Oils

___ Aro. 1016 in Capac.
___ Aro. 1016 in Hydraul.
___ Aro. 1016 in Trans.
___ Aro. 1242 in Capac.
___ Aro. 1242 in Hydraul.
___ Aro. 1242 in Trans.
___ Aro. 1254 in Capac.
___ Aro. 1254 in Hydraul.
___ Aro. 1254 in Trans.
___ Aro. 1260 in Capac.
___ Aro. 1260 in Hydraul.
___ Aro. 1260 in Trans.

___ Volatile Organics
___ Other__________
___ Other__________

Water Supply Samples

___ WS Corrosivity/Sodium
___ WS Herbicides
___ WS Nitrate/Fluoride
___ WS Chl. Hyd. Pest. I
___ WS Chl. Hyd. Pest. II
___ WS Res. Free Chlorine
___ WS Trace Metals
___ WS Trihalomethanes
___ WS Turbidity
___ Other__________
___ Other__________

Priority Pollutants/Hazardous Wastes/Toxic Chemicals

___ Aromatic Purgeables
___ Benzidines
___ Chlorinated Hydrocarbons
___ Chl. Hyd. Pest. WP - I
___ Chl. Hyd. Pest. WP - II
___ Chl. Hyd. Pest. WP - III
___ Cyanide
___ Dichlorobenzenes
___ EP Metals
___ GC/MS Acids
___ GC/MS Base Neutrals - I
___ GC/MS Base Neutrals - II
___ GC/MS Base Neutrals - III
___ GC/MS Pesticides - I
___ GC/MS Pesticides - II
___ GC/MS Purgeables - I
___ GC/MS Purgeables - II
___ GC/MS Purgeables - III
___ GC/MS Purgeables - IV
___ Haloethers

___ Halo. Purgeables - I
___ Nitroaro. & Isophorone
___ Nitrosamines

PCBs (specific Aroclors)

___ Aroclor 1016
___ Aroclor 1221
___ Aroclor 1232
___ Aroclor 1242
___ Aroclor 1248
___ Aroclor 1254
___ Aroclor 1260
___ Aroclor 1262

___ Phenols (GC)
___ Phthalate Esters
___ Polynuclear Aromatics I
___ Polynuclear Aromatics II
___ Polynuclear Aro. SRM 1647
___ Other__________

Biological Samples

___ Chlorophyll Fluoro.
___ Chlorophyll Spectro.
___ Phytoplankton
___ Simulated Plankton
___ Other__________
___ Other__________

Date Requested: ______________________ Date Shipped: ______________________

EPA-360 (Cin) (Rev. 7/83, Pt. 1)

Fold Here

Place Stamp
Here

Quality Assurance Branch
Environmental Monitoring and Support Laboratory
U.S. Environmental Protection Agency
Cincinnati, OH 45268

Fold Here

[illegible]-360 (Cin) (Rev. 7/83, Pt. 2)

PLEASE COMPLETE THE FORM AND MAIL TO:

Form Approved O.M.B. 2000-0139
Exp. 4-30-86

QUALITY ASSURANCE BRANCH, EMSL-CINCINNATI, U.S. ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH 45268

Concentrations are 5,000 µg of QAS-pure compound per mL of methanol solvent unless otherwise noted.

E070 Benzo(a)anthracene (1000 µg/mL)
E072 Benzo(b)fluoranthene (2500 µg/mL)*
E074 Chrysene (1000 µg/mL)*
E076 Anthracene (1000 µg/mL)*
E078 Fluorene
E082 Pyrene (2500 µg/mL)
E084 Toluene (10,000 µg/mL)
E088 Dieldrin (QAR)
E091 4,4'-DDE
E093 alpha-Endosulfan**
E095 Endosulfan sulfate (QAR)
E097 Endrin aldehyde
E099 Heptachlor epoxide
E101 beta-BHC (2500µg/mL)*
E103 delta-BHC (QAR)
E105 PCB-Aroclor 1254 (QAT)
E107 PCB-Aroclor 1232 (QAT)
E110 PCB-Aroclor 1016 (QAT)
E124 4,4'-DDT (QAR)
E130 PCB-Aroclor 1262 (QAT)
E136 Bromochloromethane (10,000 µg/mL)
E150 2-Chlorotoluene
E152 4-Chlorotoluene
E156 Pentachloronitrobenzene
E169 Benzyl chloride
E171 1,2-Dibromoethane (10,000 µg/mL)
E173 cis-1,2-Dichloroethylene (10,000 µg/mL) (QAR)
E176 1,3,5-Trichlorobenzene
E180 2,4,6-Trichloroaniline
E182 3-Chlorophenol
E200 Chlorodibromomethane (10,000 µg/mL) (QAR)
E203 para-Xylene
E214 1,3-Dichlorobenzene
E219 Mirex (1000 µg/mL)*
E220 Aldrin (QAR)
E224 2,4-Dimethylphenol (QAR)
E231 Dibenzo(a,h)anthracene (1000 µg/mL)**
E239 n-Tridecane
E241 n-Pentadecane
E260 Pentachlorobenzene (2,500 µg/mL)
E311 Methyl ethyl ketone (10,000 µg/mL)
E360 Carbon Tetrachloride (10,000 µg/mL)
E471 PCN Halowax 1001 (QAT)
E548 N,N-Dimethylformamide

E071 Benzo(a)pyrene (1000 µg/mL) (QAR)*
E073 Benzo(k)fluoranthene (1000 µg/mL)*
E075 Acenaphthylene (QAR)
E077 Benzo(g,h,i)perylene (1000 µg/mL)**
E079 Phenanthrene
E083 Tetrachloroethylene (10,000 µg/mL)
E085 Trichloroethylene (10,000 µg/mL)
E089 Chlordane (QAT)
E092 4,4'-DDD
E094 beta-Endosulfan**
E096 Endrin (QAR)
E098 Heptachlor
E100 alpha-BHC (2500 µg/mL)
E102 gamma-BHC (Lindane)
E104 PCB-Aroclor 1242 (QAT)
E108 PCB-Aroclor 1248 (QAT)
E109 PCB-Aroclor 1260 (QAT)
E111 Toxaphene (QAT)
E126 PCB-Aroclor 1221 (QAT)
E131 PCB-Aroclor 1268 (2500 µg/mL)* (QAT)
E149 2,4-Dichlorotoluene
E151 3-Chlorotoluene
E153 4-Chlorobenzotrifluoride
E168 alpha, alpha, 2,6-Tetrachlorotoluene
E170 2,3-Chloro-1-propylene (10,000 µg/mL) (QAR)
E175 1,2,3-Trichlorobenzene
E177 1,2,4,5-Tetrachlorobenzene (2,500 µg/mL) (QAR)
E183 4-Chlorophenol
E201 ortho-Xylene
E202 meta-Xylene
E212 Bromoform (10,000 µg/mL) (QAR)
E218 cis and trans 1,3-Dichloropropylene (5,000 µg/mL each) (QAR)
E222 2,3,5-Trichlorophenol (QAR)
E225 1,2,3,4-Tetrachlorobenzene (2500 µg/mL)
E238 n-Dodecane
E240 n-Tetradecane
E258 Epichlorohydrin (10,000 µg/mL)
E271 Pyridine (10,000 µg/mL)
E330 2,4-Dichlorophenoxyacetic acid (2,4-D) (QAR)
E470 PCN Halowax 1099 (QAT)
E480 para-Dioxane (10,000 µg/mL)
E552 2,4,5-TP (Silvex) (QAR)

PCBs at 1000 µg/mL in 5 mL isooctane

E125 PCB-Aroclor 1016 (QAT)
E132 PCB-Aroclor 1242 (QAT)
E129 PCB-Aroclor 1260 (QAT)
E135 PCB-Aroclor 1254 (QAT)

Surrogates and Internal Standard for EPA GC/MS Methods 624 and 625

E193 2-Fluorophenol (QAR) (100 µg/mL)*
E194 2-Fluorobiphenyl (100 µg/mL)*
E195 1-Fluoronaphthalene (100 µg/mL)*
E196 1,4-Dichlorobutane-d_8 (150 µg/mL)
E233 4-Bromofluorobenzene (150 µg/mL)
E234 4,4'-Dibromooctafluorobiphenyl (100 µg/mL)*

*In Acetone **In para-Dioxane ***In 2-Propanol

EPA-260 (Cin)

REFERENCES

1. Handbook for Sampling and Sample Preservation of Water and Waste Water, Federal Environmental Protection Agency, 1982.

2. Ostroff, A. G., Introduction to Oilfield Water Technology, Prentice-Hall, Inc., 1965.

3. Patton, Charles C., Oilfield Water Systems, Campbell Petroleum Series, 1981.

4. Recommended Practice for Analysis of Oil-Field Waters, American Petroleum Institute, 1968.

5. Recommended Practice for Sampling Petroleum Reservoir Fluids, American Petroleum Institute, 1966.

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